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Williams et al.

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(54) **IRRIGATION CONTROLLER WITH REMOVABLE STATION MODULES**

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(22) Filed: **Sep. 21, 1999**

Related U.S. Application Data

(63) Continuation of application No. 08/904,125, filed on Jul. 28, 1997, now Pat. No. 5,956,248, which is a continuation of application No. 08/312,268, filed on Sep. 23, 1994, now abandoned.

(51) **Int. Cl.**[7] **G06D 7/06**
(52) **U.S. Cl.** **700/284**; 700/19; 239/69
(58) **Field of Search** 700/12, 14–16, 700/18, 19, 283, 284; 239/69, 70; 361/686

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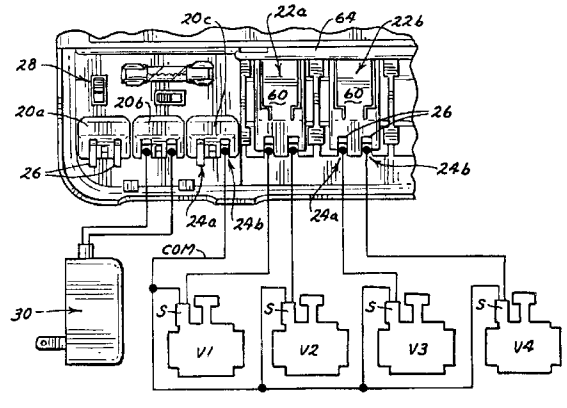
(57) **ABSTRACT**

An irrigation controller includes a housing for enclosing a microprocessor that stores and executes at least one watering program. The microprocessor has a parallel output bus with a plurality of pin sets for controlling a plurality of irrigation stations. The connection between the controller and the irrigation stations is through a plurality of station modules that are removably coupled, in any desired number, to the various pin sets on the output bus. The number of stations controlled is adjusted by the number of modules connected to the output bus. The controller housing has a pocket for holding a user's manual, which is positioned between the controller housing and a mounting bracket when the controller housing is installed on the mounting bracket.

36 Claims, 5 Drawing Sheets



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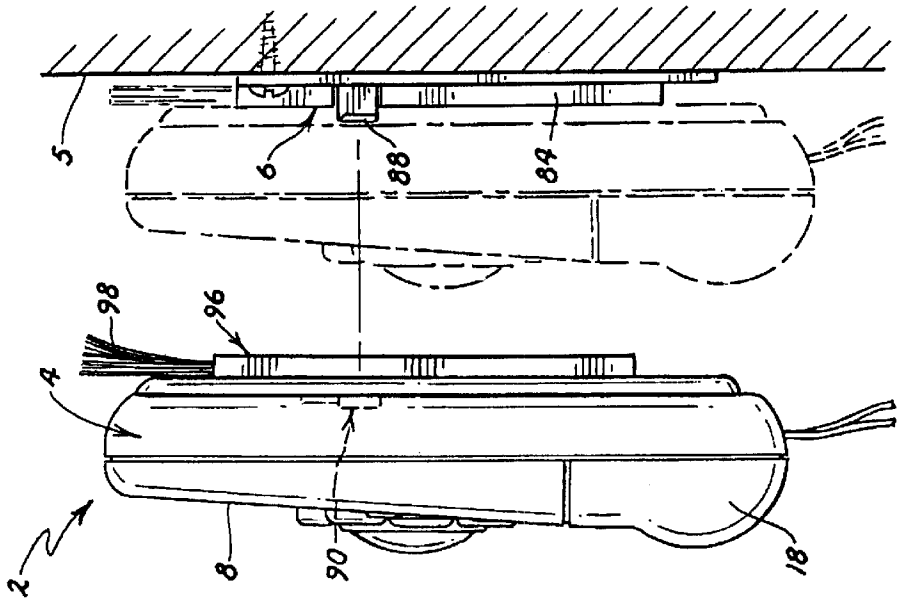
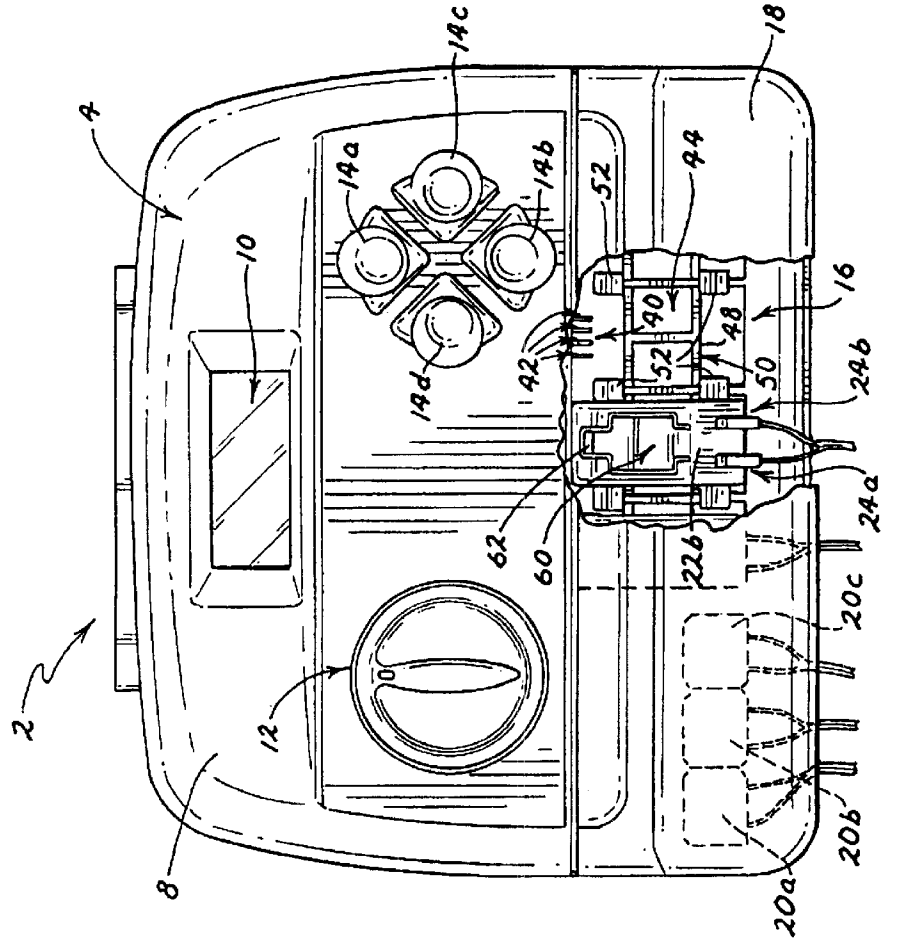

5
6
88
84
98
96
4
2
8
90
18

FIG. 2


14c
18
4
14a
14b
52
44
10
16
40
48
42
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24b
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62
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226
24a
20c
12
2
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20a

FIG. 1

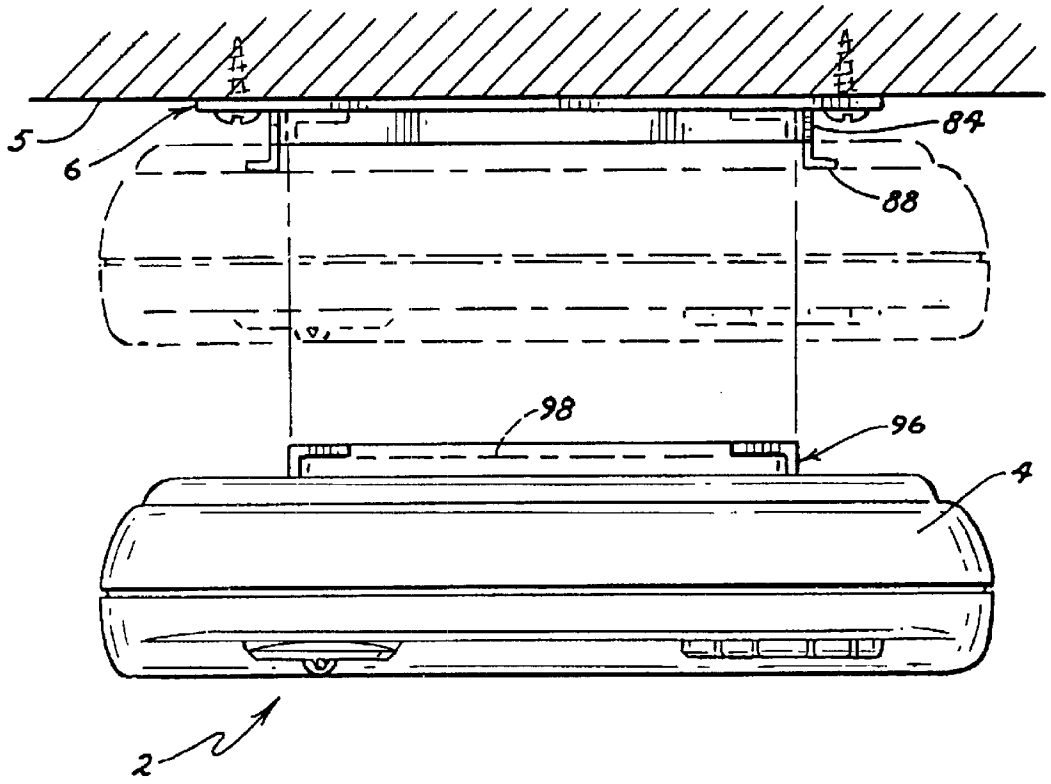


FIG. 3

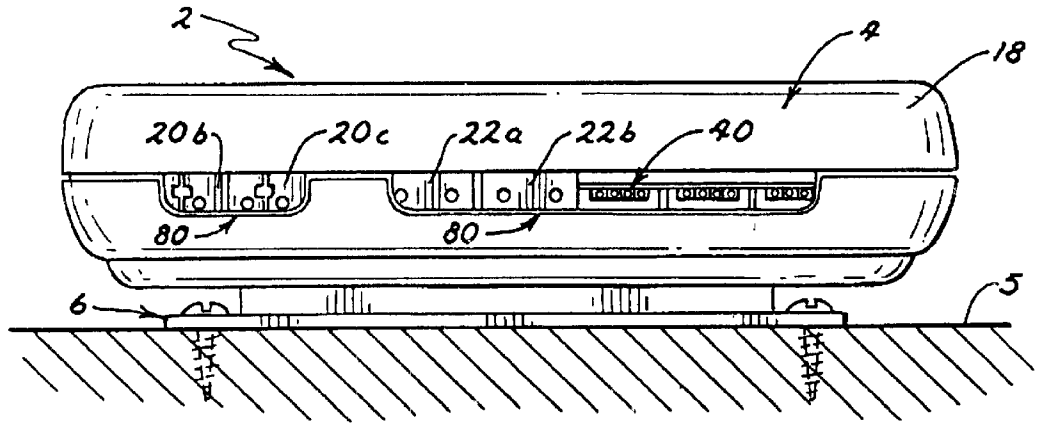


FIG. 4

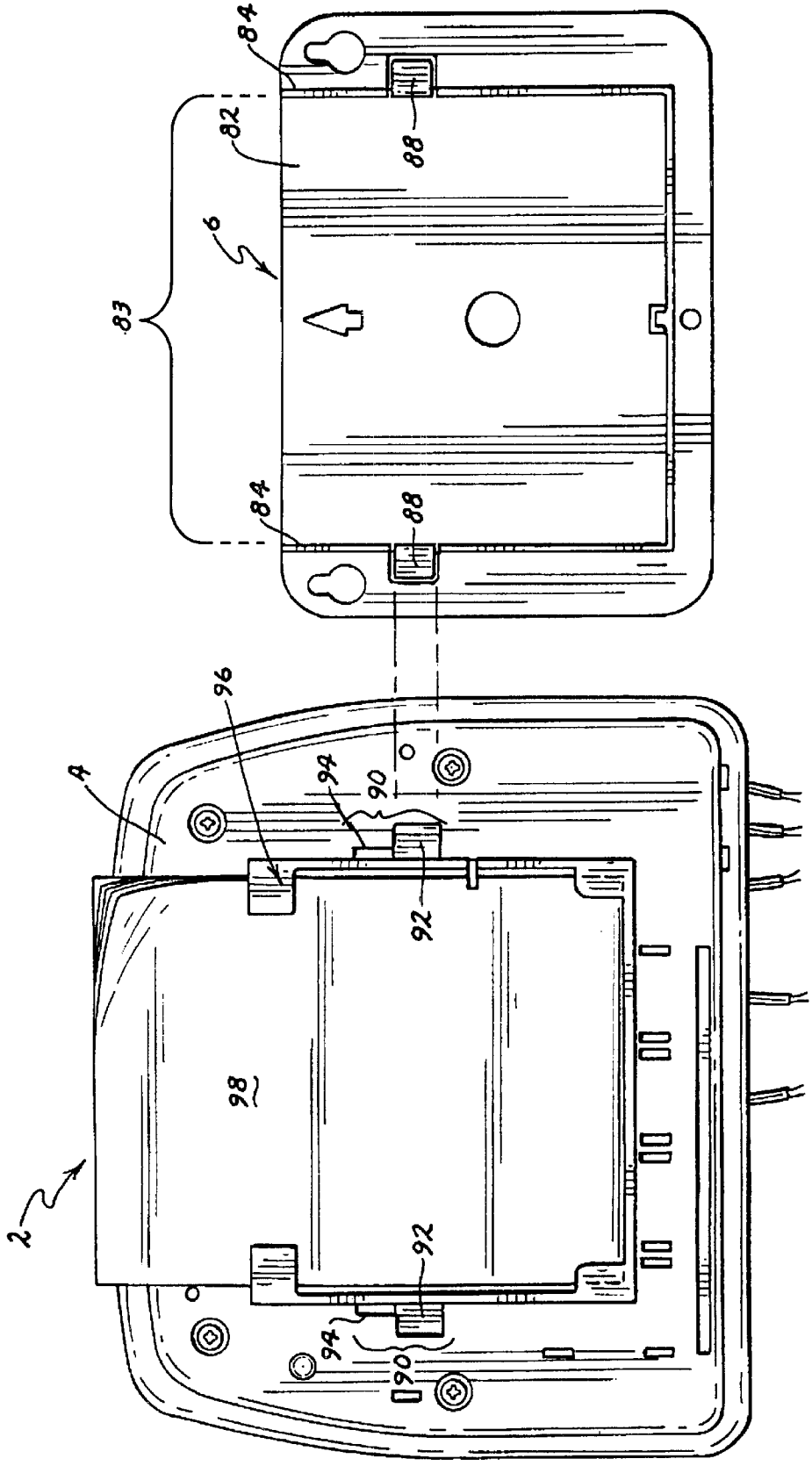


FIG. 5

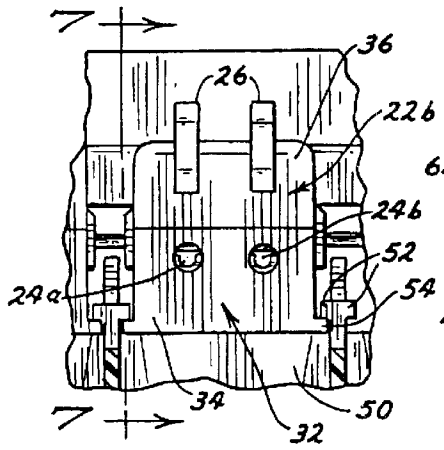


FIG. 6

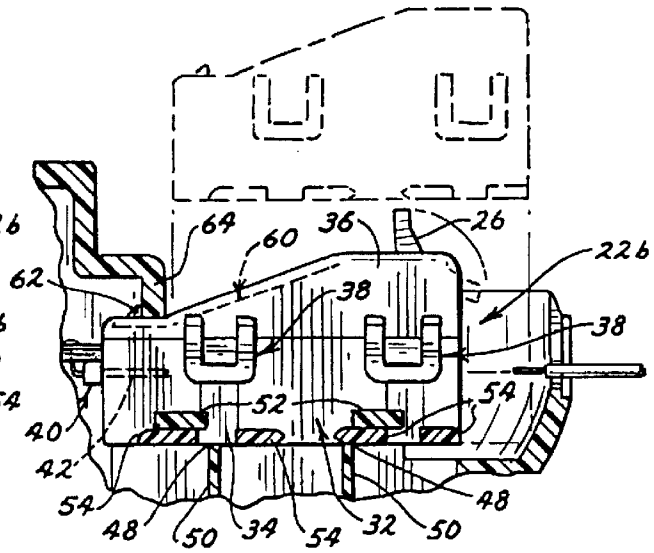
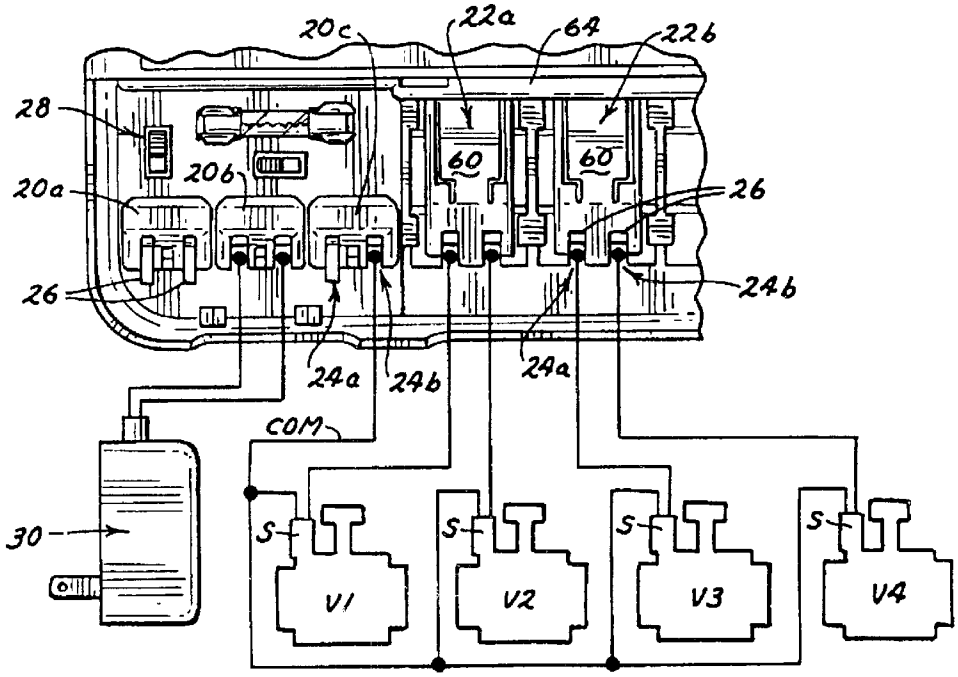


FIG. 7

FIG. 8



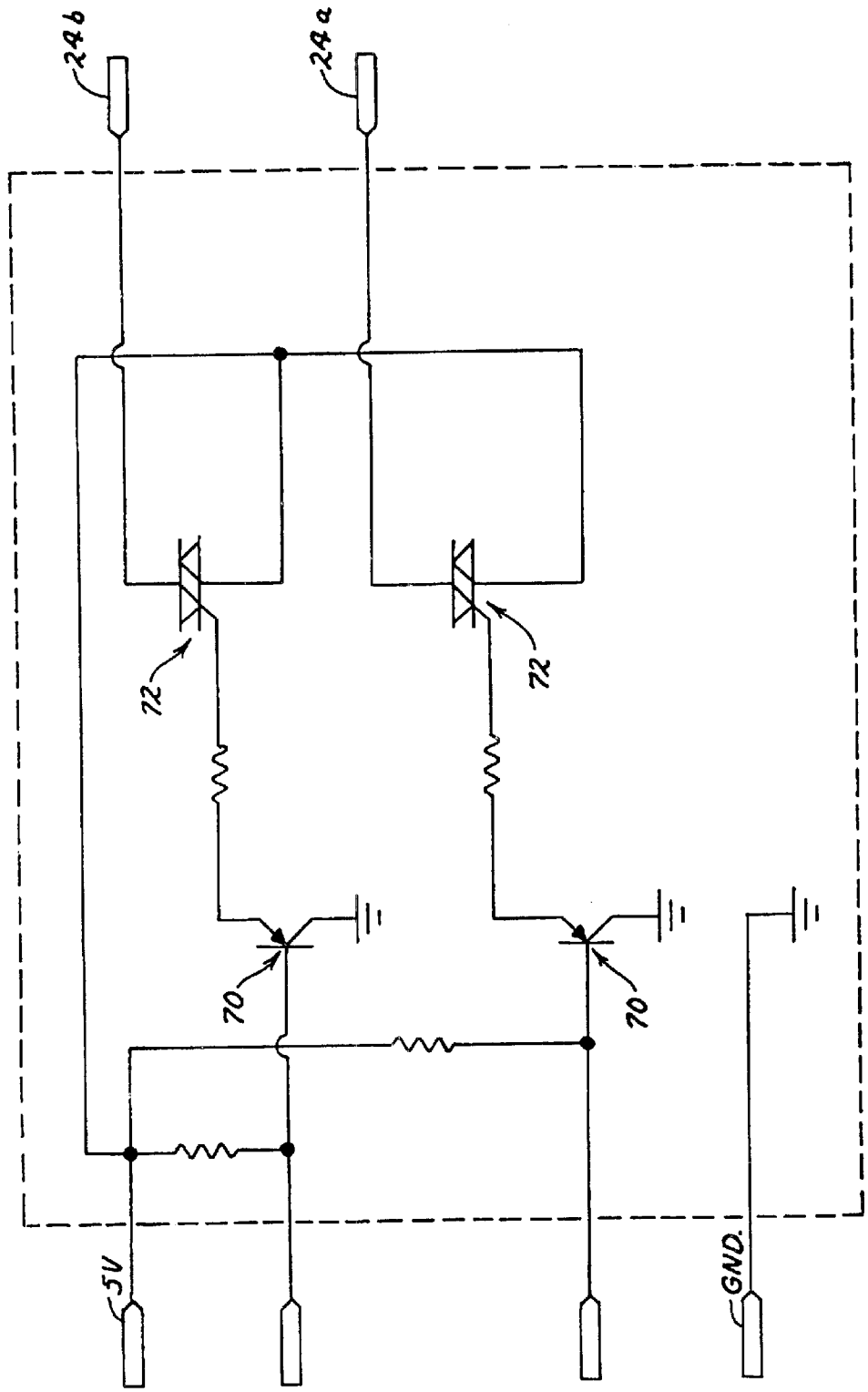


FIG. 9

IRRIGATION CONTROLLER WITH REMOVABLE STATION MODULES

This application is a continuation of application Ser. No. 08/904,125, filed Jul. 28, 1997, now U.S. Pat No. 5,956,248, which is a continuation of application Ser. No. 08/312,268, filed Sep. 23, 1994, now abandoned.

TECHNICAL FIELD

This invention relates to an irrigation controller for controlling the operation of an irrigation system pursuant to a watering schedule that may be programmed by the user. More particularly, this invention relates to an irrigation controller for controlling multiple irrigation stations.

BACKGROUND OF THE INVENTION

Irrigation controllers are known for controlling the operation of an irrigation system in accordance with the passage of time. Most controllers operate a plurality of watering stations and will retain or store a watering program established by the user. This program typically allows the user to pick what days the sprinklers will operate, what time of day that irrigation will begin, and how long each station will operate. Some controllers allow multiple watering programs to be stored.

U.S. Pat. No. 5,262,936 discloses a microprocessor based controller in which the controller base unit has drivers and switches for controlling some number of irrigation stations that is less than the maximum number that can be controlled. The station handling ability of the controller can be expanded by plugging in additional modules with each module having drivers and switches for an additional number of stations. The modules when connected extend and are part of a serial bus structure in the controller. The modules known in this prior controller are quite large and when connected to the base unit of the controller take up considerable space exteriorly of the base unit, leading to problems in finding sufficient space to receive them all and in attaching all of the modules in a secure fashion.

SUMMARY OF THE INVENTION

This invention relates to an irrigation controller which comprises a housing having microprocessor means for storing and executing a watering program for controlling a plurality of irrigation stations. The microprocessor means includes a parallel output bus within the housing having a plurality of separate station output pins for controlling the irrigation stations with one station output pin used for controlling each station. At least one module is removably plugged into at least one of the station output pins on the output bus. The module has a terminal suited for receiving an electrical lead wire extending to the irrigation station, and further has driver and switch means for activating the station as commanded by the base unit over the at least one station output pin.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be described in more detail in the following Detailed Description, taken in conjunction with the following drawings, in which like reference numerals refer to like elements throughout.

FIG. **1** is a front elevational view of an improved irrigation controller according to this invention, particularly illustrating the controller housing and front panel with its associated controls and displays and having a portion of the controller broken away to illustrate one of the removable station modules installed inside the controller housing;

FIG. **2** is a side elevational view of the controller shown in FIG. **1**, particularly illustrating the controller housing and its attachment to a mounting bracket on which the controller housing is removably installed;

FIG. **3** is a top plan view of the controller shown in FIG. **1**, particularly illustrating the controller housing and its mounting bracket;

FIG. **4** is a bottom plan view of the controller shown in FIG. **1** with the controller housing in place on its mounting bracket;

FIG. **5** is an exploded, rear elevational view of the controller shown in FIG. **1**, particularly illustrating the controller housing detached from the mounting bracket and the pocket provided on the back of the controller housing for holding a user manual for the controller;

FIG. **6** is an enlarged front elevational view of one of the station modules of the controller with the module shown installed in the controller of FIG. **1**;

FIG. **7** is a cross-sectional view taken along lines **7**—**7** of FIG. **6**, particularly illustrating how the station module is installed in the controller of FIG. **1**;

FIG. **8** is a partial front elevational view of the controller shown in FIG. **1**, with the terminal strip cover being removed to show two station modules for controlling four irrigation stations and the rain sensor, **24** V AC and pump and common outputs contained on the terminal strip; and

FIG. **9** is a schematic diagram of one of the station modules used in the controller of FIG. **1**.

DETAILED DESCRIPTION

This invention relates to an irrigation controller **2** for controlling the operation of an irrigation system in a timed manner. More specifically, controller **2** allows the user to select or input at least one watering program comprising the following parameters of irrigation system operation:

- which days the sprinklers will operate in a particular 7 day window (i.e. a calendar sequence) or the interval between successive operational days up to a maximum interval of 7 days (i.e. an interval sequence), the operational days being known as "active days";
- when the sprinklers come on during the active days, known as the "start times", with up to four start times being selectable; and
- how long the sprinklers will run after each start, known as the "run times".

Controller **2** is adapted to control a plurality of separate watering "stations" in the irrigation system. Each station comprises one or more sprinklers grouped together to operate simultaneously off the same irrigation valve V. Each irrigation valve V includes an actuator, such as an electrical solenoid S, which is operated by a control signal from controller **2** to turn valve V on.

Controller **2** of this invention can be easily adapted to control different numbers of stations up to a total of eight stations. A four station controller **2** is illustrated in this application. Referring to FIG. **8**, the four stations are illustrated by the four separate irrigation valves **V1**, **V2**, **V3** and **V4** wired to controller **2**. There will be six irrigation valves **V1**–**V6** wired to controller **2** in a six station controller, eight valves **V1**–**V8** in an eight station controller, and so on. While eight is the maximum number of stations that can be controlled by controller **2** shown herein, the maximum number of stations can obviously be adjusted to a larger number if so desired.

For each watering program stored in controller **2**, a run time may be set individually for each separate station, i.e. different stations may have different run times depending on operator preference. However, the selections of active days and start times apply to all stations as a group within each watering program. Thus, when an active day and start time is reached when executing a particular watering program, controller **2** will operate the irrigation system by sequencing through the stations and operating each station for the run time which has been set for that station on that particular program. Sequential operation of the stations is preferred to decrease the demands on the water delivery capacity of the irrigation system.

Controller **2** incorporates a microprocessor (not shown) of any suitable design which comprises a timing, memory, logic and control means. The microprocessor monitors the passage of time and executes whatever watering program has been input and selected by the user for execution. Operational flexibility is achieved by allowing controller **2** to store and execute multiple watering programs so that a different combination of active days, start times, and run times can be stored in different programs if so desired. The microprocessor can also permanently store a default watering program for use if the user fails to input a customized watering program or programs of the user's own design.

Typical irrigation controllers based on the use of microprocessors are disclosed in U.S. Pat. Nos. 5,262,936 and 5,272,620, owned by the assignee of this application. These patents are hereby incorporated by reference.

Referring to FIG. **1**, the electronic components of controller **2**, including the microprocessor, are contained within a housing **4** of any suitable design. As will be described in more detail hereafter, housing **4** may be mounted on a wall **5** using a mounting bracket **6**. Housing **4** includes a front panel **8** having various operational controls which may be manipulated by the user to activate control functions of controller **2** or to input information into controller **2**. In addition, controller **2** includes a display device **10** for displaying information to the user.

The operational controls of controller **2** include a rotary knob or dial **12** for selecting various ones of the programmable parameters that can be input and stored in a watering program, and various push button controls identified generally as **14**. Push button controls **14** include "up/down" or "plus/minus" keys **14***a*, **14***b* for incrementing or decrementing the value of a particular parameter when programming the controller, an "enter" key **14***c* for accepting a particular value of a parameter and for proceeding to the next step in the programming sequence, and an "escape" key **14***d* to start over during programming. Thus, by rotating dial **12** to a particular position corresponding to a particular parameter that can be input, the user can then manipulate controls **14** to input and store values for the selected parameter while observing in display device **10** the values as they are being input for that parameter through the operation of controls **14**.

The type of watering program stored in controller **2**, namely the number and nature of the parameters that can be set and stored in a watering program and then executed by controller **2**, can obviously be varied. In addition, the nature of the operational controls **12**, **14** used to input the watering program or access the features of controller **2** can also obviously be changed. This invention relates to other features of controller **2**, to be described in detail hereafter, that can be used generally on any irrigation controller that controls a plurality of stations, without being limited to controller **2** as shown herein.

A lower portion of controller **2** houses an input/output terminal area, identified generally as **16**, behind an easily removable access strip or panel **18**. Panel **18** is configured to snap onto and off of controller housing **4** using known tab and slot connections. Terminal area **16** includes space for three, terminal blocks **20***a*, **20***b*, and **20***c* which are hard-wired into place. In addition, terminal area **16** includes space for up to four, two-station modules **22***a*, **22***b*, etc. that are used to connect controller **2** to the irrigation stations comprising valves V. Station modules **22** are generally identical to one another and are easily removable from controller **2**—modules **22** simply plug into controller **2** and can be easily unplugged from controller **2** in a manner to be described shortly,

Terminal blocks **20** and station modules **22** each have two snap-in wire terminals **24***a*, **24***b* therein for receiving two connecting wires. Such terminals are well known in the electrical connection art. They each have a pivotal lever **26** that may be rotated 90° from an open position (where lever **26** is vertical and the wire may be inserted into the terminal) to a generally closed position (where lever **26** is horizontal and the wire is clamped or retained in the terminal). The use of such snap-in wire terminals is preferred as it eases the task of connecting the necessary wires to controller **2**. Other quick coupling devices could be used, or conventional screw type terminals could be used, in place of snap-in terminals **24***a*, **24***b*.

The nature of the wires that are connected to the various terminal blocks **20** and station modules **22** will vary. For example, the first terminal block **20***a* connects to the two lead wires of a rain switch (not shown) which determines if it is raining and allows controller **2** to cease operation in the case of rain. A typical rain switch of the type which may be connected to terminal block **20***a* is described in U.S. Pat. No. 5,101,083, which is hereby incorporated by reference. An on/off switch **28** can be mounted in terminal area **16** immediately above terminal block **20***a* for the rain switch. In the off position of switch **28**, the rain switch input is ignored by controller **2** such that the detection of rain will not affect the operation of controller **2** or the irrigation system.

The second terminal block **20***b* is used for the convenient connection of an external electrical transformer **30** used to provide AC power to controller **2**. Transformer **30** will be wired or plugged into a standard AC power source such as 120V AC power, and will provide 24V AC power to controller **2**. Ultimately, such 24V AC power will be used to activate solenoids S on irrigation valves V. Additionally, such power can be routed through one of the terminals in terminal block **20***c* to activate a solenoid S on a master valve or a relay on an irrigation pump. This is required in irrigation systems where a source of pressurized water is not continually present upstream of valves V, but is provided only when irrigation is to take place. In this event, either a master valve supplying valves V must first be opened, or a pump started, to ensure supply of pressurized water to valves V.

The third terminal block **20***c* as noted above uses one of the snap-in terminals, namely terminal **24***a*, as a master valve or pump relay output for supplying 24V AC power from controller **2** to these components. The other terminal **24***b* in terminal block **20***c* is used as a common wire connection COM to ground. Thus, all of the common wires for all of the irrigation valves V may be spliced together, as shown in FIG. **8**, and connected to ground using the common wire terminal **24***b* in terminal block **20***c*. In addition, when operating a master valve or pump, the common wire for such master valve or pump may also be spliced into and connected to the common wire connection COM leading to common wire terminal **24***b*.

Station modules **22** are used to allow controller **2** to control a desired number of stations determined by the

number of modules **22** that are installed. Each module **22** has two snap-in terminals **24***a*, **24***b* for controlling two stations, with each terminal being connected to the non-common wire lead from a solenoid S. A module **22** could be used to control only one station if only of the snap-in wire terminals **24***a*, **24***b* is connected to a single solenoid. However, if both terminals are being utilized, then each module **22** will control two stations, i.e. two of the irrigation valves V. See FIG. **8**.

Controller **2** is provided with means for accepting up to a predetermined maximum number of modules **22** to control up to a predetermined maximum number of stations V. There is space in controller **2** for accepting up to four modules **22** side-by-side in terminal area **16**, thus allowing up to eight stations to be controlled. If one module **22** is installed, then up to two stations can be controlled, with two modules **22** up to four stations can be controlled, and so on. FIG. **8** illustrates a configuration having two modules installed controlling four stations represented by the four irrigation valves V1–V4.

Referring to FIGS. **1**, **6** and **7**, each station module **22** includes a casing **32** having a generally rectangular base **34** secured to a tapered top **36**. Base **34** and top **36** may be separable to allow a printed circuit board to be inserted into module **22** during manufacture, with base **34** and top **36** then being snapped together and held as a unit by suitable connectors **38**. One end of module **22** includes the two snapin wire terminals **24***a*, **24***b* representing the output end of module **22**. The other or input end of module **22** has a plug connection for allowing module **22** to be plugged into one set **40** of four output pins **42** on a parallel output bus in controller **2**. In each set **40** of pins **42**, one pin is assigned to control one of the terminals **24***a* and **24***b*, respectively, another pin is a ground connection, and the remaining pin is a 5V power input to module **22**. See FIG. **9**. Thus, when module **22** is in place and is plugged into the parallel output bus, controller **2** will activate the stations connected to module **22** as called for by the watering program being executed by controller **2**.

Terminal area **16** of controller **2** is provided with four slots **44** in which modules **22** are slidably received, with one slot **44** being provided for each module **22**. Each slot **44** is formed by the upper aligned surfaces **48** of a plurality of spaced vertical walls **50** in terminal area **16**, such surfaces **48** defining a plane against which the bottom of module **22** may be engaged. Each slot **44** further has two spaced overhanging lips **52** on either side thereof which are spaced from one another and are elevated above the upper aligned surfaces **48** of walls **50**. Lips **52** are suited to slidably engage with a plurality of guide tabs **54** that jut out from the sides of modules **22** to guide modules **22** in slots **44**.

As shown most clearly in FIGS. **1** and **7**, to insert a module **22** into one of the slots **44** in terminal area **16**, module **22** is positioned as shown in phantom above slot **44** with guide tabs **54** on modules **22** being located in the gaps between the spaced lips **52**. Module **22** is then dropped downwardly until the bottom thereof rests on the upper aligned surfaces **48** of vertical walls **50**. Module **22** is then pushed inwardly in slot **44** relative to the parallel output bus until the pin set **40** on the bus plugs into the connector provided therefore in the input end of module **22** as shown in solid lines in FIG. **1**. In this position, guide tabs **54** on module **22** have slid beneath lips **52** on the sides of slots **44**.

The top of each module is provided with means forming a spring biased latch. More specifically, this latch is provided by a section **60** of the top wall of module **22** that is cut away along its sides and rear but is joined to module **22** at the front, in effect being supported in the manner of a cantilever. This section **60** will have a natural outward biasing force which tends to keep this section **60** aligned with the remaining portions of the top wall of module **22**. The rear of section **60** is provided with an upwardly protruding hook **62**. Hook **62** is adapted to engage against the rear side of a vertical wall **64** that overlies the inner end of slot **44**.

As module **22** is slid into place in a slot **44** (after it has been dropped into place in slot **44** with guide tabs **54** ready to be pushed beneath lips **52**), hook **62** will be cammed down beneath vertical wall **64** with the cut away top wall section **60** deflecting down as necessary to allow this movement. When hook **62** clears wall **64** as module **22** plugs into the pin set **40** on output bus, the cut away section **60** of the top wall will spring back upwardly to its normal untensioned state where it is generally aligned with the remainder of the top wall. Thus, hook **62** and cut away section **60** of the top module wall form, in effect, a spring biased latch for firmly locking module **22** in place in slot **44**.

To remove any particular module from its slot **44**, the user simply presses down on the cut away section **60** of the top wall to disengage hook **62** from behind vertical wall **64**, and then pulls slightly outwardly on module **22** to clear guide tabs **54** from beneath lips **52** and to unplug module **22** from the output bus. Module **22** is then simply lifted up out of slot **44**. Thus, the actions required to remove a module **22** are the reverse of those used to install module **22**.

The electronic circuitry for activating the solenoid S on the valves V is contained on the printed circuit board that is carried within each module **22**. Referring to FIG. **9**, this circuitry comprises a transistor driver **70** for activating a TRIAC switching device **72**. Each terminal **24***a*, **24***b* is connected to its own transistor/TRIAC combination **70172**. Thus, when controller **2** determines that a particular valve V should be opened, it does so by activating the appropriate transistor **70** to close the appropriate TRIAC **72**, thus activating the solenoid of the appropriate valve.

The use of plug in, removable station modules **22** for serving as the connection to the irrigation stations allows controller **2** to have great versatility. If only a four station controller is needed, only two modules **22** need be used. Thus, the user can tailor controller **2** to control precisely only those numbers of stations that are required for a particular irrigation system. In addition, modules **22** are all conveniently located within, and protected by, housing **4** of controller **2**. Thus, controller **2** is compact and not unduly bulky. The bottom of controller housing **4** includes various ports or openings **80** for routing wires to and from terminal area **16** for connection to terminal blocks **20** or station modules **22**. See FIG. **4**.

The Applicants have found that controller **2** will have great resistance to lightning strikes that may induce surge currents on the station wires. In previous controllers, the energy from such a strike will often be conducted back to controller **2** along the wires connecting controller **2** to the particular station affected by the strike. Since these wires are usually connected directly to a terminal strip that is hard-wired to the main printed circuit board of controller **2**, i.e. to the circuit board having the microprocessor controller, this energy could often damage many of the controller's components, including the microprocessor.

However, with modules **22** of the present invention, Applicants have found that much of the energy from a lightning strike will be absorbed by the electronic circuitry within module **22** without damaging the main printed circuit board in controller **2**. Thus, while module **22** itself may be destroyed by the lightning strike, it is a simple matter to

replace this module with a new one. This is an easy and inexpensive task compared to the cost of repairing or replacing the main circuit board of the entire controller **2**.

Turning now to the mechanical mounting of controller **2** on the wall, as shown in FIG. **5**, the mounting bracket **6** includes a planar surface **82** that may be screwed or in some other way fixed to the wall. A pocket receiving space **83** is formed on this mounting bracket **6** which is bounded by two spaced side walls **84**, by a bottom wall **86** and by the planar surface **82** of bracket **6**. This space **83** has a predetermined depth determined by the depth of side walls **84**. Each side wall **84** has an outwardly protruding tab **88** on the front side thereof spaced away from planar surface **82** by an appropriate distance.

The rear surface of controller housing **4** has a bayonet type slot structure **90** for receiving tabs **88** on mounting bracket **6**. Basically, each tab **88** is initially received into an open rectangular portion **92** of slot **90**, and controller housing **4** can then be slid down relative to mounting bracket **6** until tabs **88** are received behind wall portions **94** of slot **90**. Thus, controller housing **4** can be removably attached to wall **5** using mounting bracket **6**, and can be slid onto and off of mounting bracket **6** at will.

The rear surface of controller housing **4** includes a rearwardly protruding pocket **96** for holding a user's or operator's manual **98**. The depth and size of pocket **96** is sufficient to allow pocket **96** to be received in the pocket receiving space **83** provided on bracket **6** between side walls **84**. Thus, when controller housing **4** is in place on mounting bracket **6**, the space **83** between housing **4** and the planar surface **82** of mounting bracket **6** is used to conveniently store the user's manual **98**. See the phantom line illustration in FIG. **2**.

It is a great advantage to have the user's manual located in a readily accessible manner on controller **2** housing. The user need not go look for the manual in some remote space when some question arises as to the programming or operation of controller **2**. In addition, the manual storage is done in an out-of-the way, unobtrusive location, thus enhancing the probability that it will be used for this purpose.

Various modifications of this invention will be apparent to those skilled in the art. Thus, the scope of this invention is to be limited only by the appended claims.

What is claimed is:

1. An irrigation controller comprising:

a housing having a microprocessor for storing and executing a watering program for controlling a plurality of irrigation stations, wherein the microprocessor includes a parallel output bus within the housing having a plurality of separate station output pins for controlling the irrigation stations with one station output pin used for controlling each station; and

a plurality of receptacles disposed in said housing, each receptacle ensuring a direct electronic connection to said output pins;

a selection of modules, at least two of which being configured for interchangeable placement into at least two of said receptacles within said housing, each of said modules having a terminal suited for receiving an electrical lead wire extending to the irrigation station, each of said modules further having a driver and switch for activating the station as commanded by the microprocessor over the at least one station output pin.

2. The irrigation controller of claim **1**, wherein a plurality of modules may be plugged into the output bus for controlling a plurality of stations.

3. The irrigation controller of claim **2**, wherein each module has a plurality of terminals for receiving a plurality of electrical lead wires extending to a plurality of irrigation stations.

4. The irrigation controller of claim **3**, wherein each terminal is a snap-in wire terminal for receiving a separate electrical lead wire extending to each irrigation station controlled by that module, wherein each snap-in wire terminal includes a movable lever that may be moved from an open position in which the wire may be inserted into the terminal to a closed position in which the wire is clamped or retained in the terminal.

5. The irrigation controller of claim **2**, further including a removable access panel on the housing for providing access within the housing to ease installation or removal of the modules.

6. An irrigation controller comprising:

a microprocessor for storing and executing a watering program for controlling a plurality of irrigation stations;

at least two slots adapted to receive a removable station module, each of said at least two slots having an electronic connection to said microprocessor; and

at least two removable station modules, each of said removable station modules being coupled to said microprocessor through a corresponding one of said at least two slots, wherein each of said at least two removable station modules is secured within its corresponding slot via a spring biasing member.

7. The irrigation controller of claim **6**, wherein the removable station modules are configured to be received and retained within the slot without using tools.

8. An expandable irrigation controller comprising:

a microprocessor;

a plurality of slots; each slot including an electronic connection to said microprocessor; and wherein each slot includes at least one guide member;

a plurality of removable station modules, wherein each of said removable station modules is connectable with said microprocessor through a corresponding one of said plurality of slots; and wherein each removable station module includes at least one alignment member, said alignment member being formed to slidably engage said guide member of a corresponding said slot; and

a spring biasing element adapted to secure said removable station module within said slot of said irrigation controller.

9. The expandable irrigation controller of claim **8**, wherein each of said plurality of slots includes a mechanical electronic connector mateable with a removable station module, wherein each mechanical electronic connector couples a removable station module to said microprocessor of said expandable irrigation controller.

10. The expandable irrigation controller of claim **9**, wherein said spring biasing element is separate and distinct from said mechanical electronic connector.

11. The expandable irrigation controller of claim **8**, wherein each of said plurality of removable station modules includes one or more electronic switching devices for switching on and off one or more irrigation stations.

12. The expandable irrigation controller of claim **11**, wherein each of said electronic switching devices includes at least one transistor driver coupled to at least one TRIAC switching device.

13. The expandable irrigation controller of claim **8**, wherein at least one of said plurality of removable station modules includes at least one wire terminal for receiving an electrical lead wire extending to an irrigation station controlled by said removable station module.

14. The expandable irrigation controller of claim 13, wherein said wire terminal includes a movable lever that may be moved from an open position in which said lead wire may be inserted into said wire terminal to a closed position in which said lead wire is clamped or retained in said wire terminal.

15. The irrigation controller of claim 1, wherein each of said modules includes at least two terminals.

16. The irrigation controller of claim 1, wherein each of said modules contains electronic circuitry configured to absorb energy from a lightning strike.

17. The irrigation controller of claim 1, wherein said housing includes a surface for displaying operating instructions.

18. The irrigation controller of claim 1, wherein each receptacle includes a conductor in electronic communication with said microprocessor.

19. The irrigation controller of claim 18, wherein said conductor is located beneath a wall of said receptacle.

20. The irrigation controller of claim 1, wherein each receptacle has a top wall and a bottom wall.

21. The irrigation controller of claim 20, wherein said bottom wall includes a guiding structure.

22. The irrigation controller of claim 1, wherein each module is received in a receptacle via a spring biased member.

23. The irrigation controller of claim 1, wherein each of said modules is configured to be received and retained within said receptacle without using tools.

24. The irrigation controller of claim 6, wherein each of said at least two removable station modules includes at least two terminals.

25. The irrigation controller of claim 6, wherein each of said station modules contain electronic circuitry configured to absorb energy from a lightning strike.

26. The irrigation controller of claim 6, wherein said controller further includes a surface for display operating instructions.

27. The irrigation controller of claim 6, wherein each slot includes a conductor in electronic communication with said microprocessor.

28. The irrigation controller of claim 27, wherein said conductor is located beneath a wall of said slot.

29. The irrigation controller of claim 6, wherein each slot has a top wall and a bottom wall.

30. The irrigation controller of claim 29, wherein said bottom wall includes a guiding structure.

31. The irrigation controller of claim 8, wherein each of said removable station modules includes at least two terminals.

32. The irrigation controller of claim 8, wherein each of said removable modules contain electronic circuitry configured to absorb energy from a lightning strike.

33. The irrigation controller of claim 8, wherein said controller includes a surface for displaying operating instructions.

34. The irrigation controller of claim 8, wherein each slot includes a conductor in electronic communication with said microprocessor.

35. The irrigation controller of claim 34, wherein said conductor is located beneath a wall of said slot.

36. The irrigation controller of claim 8, wherein each slot has a top wall and a bottom wall.

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